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RESEARCH PAPER

Positive Automatic Cognitions Mediate the Relationship Between Personality and Trait Positive Affect

Owen Richard Lightsey Jr. · George Gharibian Gharghani · Aron Matthew Katz · Valerie Ann McKinney · Eli Benjamin Rarey

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Abstract Positive affect (PA) has emerged as a key well-being facet and a powerful predictor of physical and psychological well-being. One of the strongest predictors of PA is personality, particularly neuroticism and extraversion. However, the mechanisms via which personality affects PA are not well-understood. Consistent with theories that accord cognitive factors a role in mediating the relationship between personality and outcomes, we tested whether positive automatic thoughts (PATs) mediated the relationship between neuroticism, extraversion, and PA among 199 college students (137 women, 70% White, 66% first and second year students, mean age = 24.13, SD = 8.86). Consistent with hypotheses, structural equation modeling indicated that PATs fully mediated the relationship between both neuroticism and extraversion and PA. The structural model fit the data well, $\chi^2/df = 2.33$, CFI = .96, SRMR = .07, RMSEA = .08 (90% CI: .06, .10), AIC = 172.45, and accounted for 58% of the variance in PA. An alternative model in which personality predicted PA, which in turn predicted PATs, did not provide as good a fit to the data, $\chi^2/df = 3.03$, CFI = .94, SRMR = .09, RMSEA = .10 (90% CI: .08, .12), AIC = 207.40. Models in which negative automatic thoughts (NATs) were construed as fully [$\chi^2/df = 4.46$, CFI = .95, SRMR = .08, RMSEA = .13 (90% CI: .11, .16)] or partially [$\chi^2/df = 4.04$, CFI = .96, SRMR = .06, RMSEA = .12 (90% CI: .10, .15)] mediating the relationship between neuroticism and negative affect did not provide a good fit to the data. A final model in which negative affect was tested a mediator of the relationship between neuroticism and NATs also did not fit the data well, $\chi^2/df = 4.03$, CFI = .96, SRMR = .07, RMSEA = .12 (90% CI: .10, .15).

Keywords Positive automatic thoughts · Positive thinking · Positive affect · Personality · Neuroticism · Extraversion · Mediation

O. R. Lightsey Jr. (✉) · G. Gharibian Gharghani · A. M. Katz · V. A. McKinney · E. B. Rarey
Department of Counseling, Educational Psychology and Research, The University of Memphis, 100 Ball Hall, Memphis, TN 38112, USA
e-mail: olightsy@memphis.edu

1 Introduction

Positive emotions have recently emerged as a key factor in adaptation and well-being (e.g. Folkman and Moskowitz 2000; Fredrickson et al. 2003; Tugade and Fredrickson 2004). Trait-resilient individuals experience positive emotions even in the midst of stressful events, and this positive affect (PA) appears to broaden thought-action repertoires, produce flexile and positive mental states (Fredrickson 2000), and foster successful adjustment to adversity (Tugade et al. 2004).

Consistent with these studies, a recent meta-analysis produced convincing evidence that PA proceeds and is likely to engender success across multiple life domains (Lyubomirsky et al. 2005) and also physical health (see Pressman and Cohen 2005 for a review and caveats). Higher PA, then, has been consistently associated with positive outcomes, and lower PA has been linked to negative outcomes. Ascertaining the factors that predict and shape PA therefore is vital.

One of the strongest and most consistent predictors of PA is personality. In particular, extraversion has long been known to have strong positive relationships with PA, and a recent meta-analysis has confirmed this result (Steel et al. 2008). This meta-analysis also indicated that prior meta-analyses had, by a wide margin, underestimated the strong positive relationship between extraversion and PA and the substantive inverse relationship between neuroticism and PA. Although some (Fujita 1993, as cited in Diener 1996) have found that neuroticism and negative affect on the one hand, and extraversion and PA on the other, may be factorially inseparable, others (Watson 2000) have argued persuasively that personality dimensions are related to a broad range of attitudinal, cognitive, and behavioral characteristics and cannot be reduced to affect. Indeed, evidence suggests that personality traits lead to actions and events and thereby shape affect (Watson 2000).

These findings are consistent with other evidence for the psychological benefits of high extraversion and the costs of high neuroticism. For example, extraversion has been strongly associated with varied indices of well-being such as happiness and quality of life (see Steel et al. 2008, for results of a meta-analysis), and also has inversely predicted mortality (Ery and Debats 2009; Iwasa et al. 2008, although other studies have found no link between extraversion and mortality and at least one study found a positive association). Similarly, general activity, a facet of extraversion, has predicted longevity (Terracciano et al. 2008). Conversely, recent evidence indicates that neuroticism may be a risk factor for depression (Sjöholm et al. 2009), alcohol use (Kuntsche et al. 2008) and alcohol-related problems (Patock-Peckham and Morgan-Lopez 2009), binge eating and drinking (Rush et al. 2009), self-induced vomiting among women (Wade et al. 2008), lower life satisfaction (Tyssen et al. 2009), depression, anxiety, and PTSD following injury (Mason et al. 2009), and many other problems.

Although much of the variance in PA and other well-being facets is due to personality, the mechanisms via which personality influences well-being are not well-understood. In this regard, several theorists have proposed that intermediate-level cognitive factors or superordinate beliefs, which exist between the levels of broad personality traits and situation-specific behaviors, may foster changes in personality or shape the relationship between stressors or personality proclivities and outcomes (e.g., Cohen and Edwards 1989; Dweck 2008; Lightsey 1996). Many theorists (e.g., Beck 1967; Dweck 2008) have argued that such schemata or beliefs play a central role in determining healthy adaptation and behavior. Studying such factors is therefore pivotal in answering the key question of whether cognitive and motivational processes linked to happiness can be acquired or taught (see Lyubomirsky 2001 for a discussion of this question).

One malleable cognitive factor that may help account for the personality—PA relationship is positive automatic thoughts (PATs). Although some theorists have construed automatic thoughts as, in effect, state constructs that arise and remit in conjunction with schemata associated with depression (e.g., some portions of Beck 1967; Stiles and Götestam 1989), others have argued with reference to automatic thoughts that an "habitual manner of thinking" (McKellar et al. 1996, p. 243) may exist and may predispose persons to life experiences that lead to affect. Similarly, Lightsey (1994a) theorized that PATs measured as traits may exert important effects on well-being, and McCann et al. (1988) proposed that automatic thoughts have far-reaching effects, resulting in "emotional, cognitive, biological, behavioral, and interpersonal response patterns" (p. 560).

Consistent with the contention that habitual styles of automatic thinking exist, scores on the Automatic Thoughts Questionnaire Positive (ATQP; Ingram and Wisnicki 1988), a well-validated measure of PATs, have exhibited a 6-week test–retest coefficient of .56 when administered with "over the last week" time-frame instructions and .65 when administered with "in general, that is, on the average" time frame instructions (Lightsey 1992)—comparable to stability coefficients of long-term PA (e.g., .58 over 8 weeks when measured with "during the past few weeks" time frame instructions, and .68 over 8 weeks when measured with "in general, that is, on the average" time frame instructions; Watson et al. 1988), which is widely considered a stable trait. Additionally, the ATQP taps dimensions of the cognitive triad that Beck and his colleagues have construed as vulnerability factors for depression (Beck 1967; Beck et al. 1979) and that have uniquely predicted future emotional travail and well-being.

Specifically, the ATQP measures positive self-evaluation and positive future expectations, as well as positive daily functioning and self-view of one's social self-worth (e.g., "I am respected by my peers") (Ingram and Wisnicki 1988), which may be related to one's view of the world—particularly the social world. Recent evidence suggests that the positive cognitive triad may in fact account for the relationship between resilience and both life satisfaction and depression (Mak et al. 2011). Indeed, there is ample evidence that PATs per se are related to PA (e.g., Burgess and Haaga 1994; Roesch et al. 2009) and also predict constructs related to PA, such as future happiness (Lightsey 1994a). PATs also have correlated inversely with depression (Ingram et al. 1990; Missel and Sommer 1983), and in several cross-sectional studies (but in only one of several two-wave panel studies) have moderated the relationship between stress and dysphoria such that, at higher levels of PATs, the positive relationship between stress and dysphoria was weaker (Bruch 1997; Lightsey 1994a, b, 1999).

Similarly, preexisting level of PATs—but not level of negative automatic thoughts (NATs)—has predicted success of cognitive therapy (Shiraishi 2005), and recent evidence indicates that PATs moderate the relationship between stress and meaning, such that persons who report higher frequencies of PATs show increased meaning after experiencing a major stressor, whereas persons who report lower frequencies of PATs show decreased meaning after experiencing a stressor (Boyraz and Lightsey, in press). Given the strong association between PA and meaning (King et al. 2006), these findings further underscore the importance of PATs to PA-related variables. Overall, then, PATs appear to constitute an enduring trait that may help shape concurrent and future well-being, including PA.

Furthermore, positive thinking has been associated with high scores on extraversion and emotional stability (Ruiz 2008), which may be construed as the inverse of neuroticism. Similarly, PATs evince negative correlations with varied indices of negative affect, a strong correlate of neuroticism (Jolly and Wiesner 1996). In toto, the above findings suggest that, consistent with theories that accord cognitive factors or beliefs a mediational role between

personality and outcomes, trait PATs may serve as an important link between personality and well-being components, particularly PA. Insofar as trait PATs constitute or reflect operation of enduring beliefs, the thesis that PATs mediate the relationship between personality and PA would also be consistent with Beck's (1967) contention that positive schemata may serve as the foundation for successful adaptation and the healthy personality.

In summary, theory suggests that cognitive factors such as PATs may account for the relationship between personality and PA. Furthermore, empirical evidence supports this possibility: Both extraversion and neuroticism have been linked to both positive thinking and PA, and PATs have been associated with PA and related indices such as happiness and meaning. However, no study has tested the possibility, consistent with many cognitive theories, that PATs mediate the relationship between both extraversion and neuroticism and PA.

The purpose of this study, therefore, was to test the hypothesis that PATs account for or mediate the well-known relationship between extraversion, neuroticism, and PA. We predicted that extraversion would be positively associated with PATs and that neuroticism would be negatively associated with PATs. We anticipated that PATs, in turn, would be positively associated with PA. Finally, we tested a plausible alternative model in which PA mediated the relationship between neuroticism, extraversion, and PATs. We did not include NATs in the model because previous studies have found that (like negative affect), negative thinking was not related to extraversion (Artistico et al. 1999) and because we anticipated that, like negative affect in many studies, NATs would have a weak or non-significant relationship with PA.

Nevertheless, neuroticism has also predicted more frequent NATs (Leucht et al. 1997) and it has been argued that NATs may mediate the relationship between neuroticism and negative affect (Wallace and Newman 1997). Indeed, NATs about the self and future (Factor II on the Automatic Thoughts Questionnaire or ATQ) predict factors related to negative affect such as susceptibility to depressive mood (Stiles and Götestam 1989), and general NATs (i.e., the full scale ATQ) have predicted future depression (Lightsey 1994a; Olioff et al. 1989). Similarly, the ATQ (Chioqueta and Stiles 2007a) or ATQ subscales (Chioqueta and Stiles 2007b) have uniquely predicted future suicidal ideation, as well as therapy-related change on both cognitive and somatic subscales of the Beck Depression Inventory (BDI: Beck et al. 1961, 1996; Furlong and Oei 2002). Therefore, we also performed supplementary analyses to examine whether NATs mediate the relationship between extraversion and neuroticism and negative affect.

2 Method

2.1 Participants

Two hundred three students at a Southern university and a community college in the Northeast properly completed all instruments (i.e., answered at least 80% of questions on each instrument) for this study, which was part of a larger study (see Lightsey et al. 2011). Three outliers with standardized residuals 3 or more SD from the mean, and one outlier with Cook's Distance and centered leverage values at least 3 SD from the mean, were removed from analyses, leaving an *N* of 199. This *N* met Anderson and Gerbing's (1988) recommendation of an *N* of at least 150, which they argued was sufficient to obtain parameter estimates with adequately small standard errors and "a converged and proper solution for models with three or more indicators per factor" (p. 416).

Mean age of this sample was 24.13 (SD = 8.86, range = 17–61). One hundred thirty-seven participants (68.8% of the sample) were women and 62 (31.2%) were men. One hundred forty participants (70.4% of the sample) were White, 42 (21.1% of the sample) were Black, 9 (4.5%) were Asian-American or Asian, 3 (1.5%) were Hispanic-American or Hispanic, and 5 (2.5%) listed their race as "other." Ninety-two participants (46.2%) were first year college students, 39 (19.6%) were sophomores, 15 (7.5%) were juniors, 15 (7.5%) were seniors, and 21 (10.6%) were graduate students. The remaining 17 participants were either working in their fields or were in high school.

2.2 Procedures

Potential participants were recruited from classes by instructors, who received a written paragraph to read to students concerning the study. In the paragraph, the project was described as "a study of factors that lead to psychological wellness." Additional participants were recruited by sending this paragraph with a link to the web-based study to a random sample of 2,000 students at the Southern university. Participants were informed that, if they completed all instruments, they would have their names entered in a raffle in which they could win a $75 gift certificate. Participants were also informed that, if they also completed instruments at time 2, they would have their names entered into a raffle to win one of three $100 gift certificates. Class instructors were also free to give class credit for participation, at their discretion.

After reading an informed consent form, participants completed a demographics form, instruments for the present study, and instruments for other studies in one of two orders. Because the SurveyMonkey website did not allow counterbalancing or randomization of instrument order, we sent two different links with widely differing instrument orders to the random sample (approximately 50% of the sample received each link) and also asked class instructors to provide each link to approximately 50% of their classes. Respondents were free to complete the surveys on their own time; there were no time constraints on completing the surveys. However, respondents needed to complete the surveys in one sitting or to leave the SurveyMonkey browser window open to continue later with their responses, since closing the window prior to completion of the surveys would have necessitated beginning the survey again (i.e., SurveyMonkey does not allow saving partial responses or beginning a subsequent session at the point one stopped during a previous session). Approximately six weeks after they completed instruments, participants were sent an e-mail reminder to complete instruments at time 2. Instruments at each time period were completed in approximately 30–50 min. Because only 31 persons completed instruments at time 2, these responses were dropped.

2.3 Instruments

2.3.1 The Big Five Inventory (BFI; John et al. 1991; John and Srivastava 1999)

The BFI was used to assess neuroticism and extraversion. The 44-item BFI consists of short phrases based on prototypical trait markers of the Big Five personality traits. Respondents are asked to complete the phrase "I See Myself as Someone Who…" as it is coupled with the 44 phrases. For neuroticism, sample phrases include "Is depressed, blue" and "Remains calm in tense situations" (reverse scored). For extraversion, sample phrases include "Is talkative" and "Is full of energy." Alpha reliabilities of the BFI scales range from .75 to .90, with a mean above .80. The reliabilities of neuroticism and extraversion are .84 and .88 respectively. In the present study, alpha reliability for neuroticism was .82, and alpha reliability for extraversion was .79.

Three-month test–retest reliabilities for the BFI averaged .85 (John and Srivastava 1999). The BFI has also demonstrated impressive convergent and divergent relationships with other Big Five measures. For example, the BFI and NEO-FFI (Costa and McCrae 1992) demonstrated corrected pairwise convergent validities of .90 for neuroticism and .83 for extraversion, with a mean value of .92 across all five factors. According to John and Srivastava (1999), the BFI retains the convenience and simplicity of measures such as Trait Descriptive Adjectives (Goldberg 1992) that use single adjectives to assess the Big Five traits, while avoiding such measures' potential problems, such as ambiguous or multiple meanings of the single terms.

2.3.2 The Automatic Thoughts Questionnaire-Positive (ATQP; Ingram and Wisnicki 1988)

The ATQP, a 30-item self-report instrument, measures positive automatic thoughts. Items consist of statements that represent thoughts; respondents rate frequency of thoughts on a 5-point Likert scale ranging from 1, "Not at all," to 5, "All the time." Item ratings are summed to produce a total score. Representative items include "I am a lucky person," "I'm fun to be with," and "There is no problem that it hopeless." Item-total correlations of the ATQP ranged from .42 to .75. Coefficient alpha was found to be .94, while split-half reliability was .95. Total ATQP score has demonstrated reliability, convergent validity, and discriminant validity (Ingram et al. 1995; Jolly and Wiesner 1996). In order to assess the mediational and predictive ability of stable positive thoughts, we utilized the time frame "in general, that is, on average" in instrument instructions (see Watson et al. 1988; Zuckerman 1960, 1983 for evidence that changing instrument instructions can tap longer-term constructs). When administered with these instructions, the ATQP has displayed a coefficient alpha of .94, a 6-week test–retest reliability of .65, and good convergent validity (Lightsey 1994a). In the present study, coefficient alpha for the ATQP was .95.

2.3.3 The Automatic Thoughts Questionnaire-Revised (ATQ; Kendall et al. 1989)

The original ATQ (Hollon and Kendall 1980) is a 30-item self-report measure that assesses the frequency of NATs that "pop into" people's heads. In theory, these thoughts reflect activation of negative schemata and are associated with depression (Hollon and Kendall 1980). Representative items include "I'm no good" and "I'm a loser." Items are scored on a 5-point Likert scale from 1 to 5, on which 5 indicates greater frequency of thoughts; item scores are summed to produce a total score. Split-half reliability, calculated on odd versus even items, was .97, and coefficient alpha was .96 (Hollon and Kendall 1980). Kendall et al. (1989) revised the ATQ by adding 10 positively-phrased items in order to reduce response set and improve psychometric characteristics. These items, however, are not included in calculation of the ATQ score. We utilized the time frame "in general, that is, on average" to tap frequency of general or trait automatic negative thoughts. Coefficient alpha was .95 and 6-week test–retest reliability was .64 when the ATQ was administered with general time frame instructions (Lightsey 1994a). The ATQ has exhibited good convergent and discriminant validity (Glass and Arnkoff 1997; Harrell and Ryon 1983; Kazdin 1990). Coefficient alpha in the present study was .95.

2.3.4 The Positive and Negative Affect Schedule (PANAS; Watson et al. 1988)

The widely-used PANAS consists of 20 self-report items, 10 of which measure PA and 10 of which measure negative affect. Participants are provided with a list of single-word

items, which consist of emotions, feelings, and sensations, and are asked to indicate on a 5-point Likert scale (1 "very slightly or not at all" to 5 "extremely") the extent they have experienced each emotion or feeling within a specified time frame. Sample feeling or emotion words for PA are "enthusiastic" and "alert," and adjectives for negative affect include "distressed" and "hostile" (Watson et al. 1988). The time frame "in general, that is, on the average" was utilized in the present study. Coefficient alpha was .88 for PA and .87 for negative affect, and 8-week test–retest reliability was .68 for PA and .71 for negative affect when the PANAS was administered with general time frame instructions in a combined sample of undergraduates, university employees, and nonuniversity adults (Watson et al. 1988). Coefficient alpha for the PA subscale and Negative Affect subscale in the present study were .87 and .91, respectively. The PANAS has been used in hundreds of studies, and ample research supports the reliability and validity of PANAS scores among college students and other populations.

3 Results

3.1 Preliminary Analyses and Procedures

Table 1 presents instrument correlation coefficients, means, and coefficient alphas, all of which were within expected ranges. A multivariate analysis of variance indicated that instrument scores did not differ across instrument order, race (White vs. Black), or gender at the $p < .01$ level, and that no interactions between gender, order, or race were significant. Multiple group comparisons in which structural model paths were constrained to be equal across gender and race (White persons and Black persons only) also indicated that the model in which PATs were construed as mediators did not differ across gender or race at the $p < .01$ level. Results of multiple group comparisons should be viewed with caution, however, due to the small sample sizes of subgroups (see Division of Statistics and Scientific Computation 2011).

Following Russell et al.'s (1998) recommendation and procedures, we created three item parcels for each latent variable prior to testing the measurement model in order to improve the distribution of the measured variables and reduce error. In order to create item parcels, we fit a one factor model using exploratory factor analysis with the maximum likelihood method to the items of each instrument. Next, we rank ordered the items of each scale from high to low based on the magnitude of their factor loadings. Finally, we sequentially assigned the ranked items of each instrument to the three respective parcels loading on the particular latent variable so as to equalize the average loading of each parcel

Table 1 Pearson product moment correlation coefficients, means, and coefficient alphas

Variable	1	2	3	4	5	6	*M*	SD	Alpha
1. Extraversion	–	−.15*	.46**	−.14*	.38**	−.10	3.33	.75	.79
2. Neuroticism		–	−.53**	.53**	−.43**	.56**	2.87	.81	.82
3. Positive thoughts			–	−.27**	.70**	−.26**	3.45	.71	.95
4. Negative thoughts				–	−.23**	.73**	1.92	.78	.97
5. Positive affect					–	−.06	3.68	.70	.87
6. Negative affect						–	2.36	.85	.91

$N = 199$

* $p < .05$; ** $p < .01$ (one-tailed)

on its factor or latent variable. Table 2 presents zero order correlations, means, and standard deviations among the observed variables (parcels) in the primary structural model and in a second model in which we examined whether NATs mediated the relationship between neuroticism and negative affect.

AMOS 7.0 (Arbuckle 2006a) and the maximum likelihood method were utilized for all analyses. Data for all indicator variables met guidelines for normality recommended by Weston and Gore (2006) (i.e., for all measured variables, skewness less than an absolute value of 3 and kurtosis less than an absolute value of 10). The largest skewness was .344 and the largest kurtosis was −.647 in the model in which PATs served as a mediator of the relationship between extraversion, neuroticism, and PA, and the largest skewness was 1.89 and the largest kurtosis was 4.07 in the model in which NATs were examined as mediators of the neuroticism–negative affect relationship.

Although the initial measurement model for testing PATs as mediators exhibited multivariate kurtosis that could have been eliminated (reduced from 18.77, critical ratio = 7.22, $p < .0001$, to 4.58, critical ratio = 1.74, $p = .08$) by removal of five additional cases with the highest Mahalanobis Distance (i.e., ranging from 29.70 to 55.84), we chose in light of the small sample size and the slightly higher RMSEA in the measurement model with these cases removed to retain these outliers. Additionally, we used bootstrapping to directly test mediational hypotheses. Bootstrapping is "a nonparametric approach to effect-size estimation and hypothesis testing that makes no assumptions about the shape of the distributions of the variables or the sampling distribution of the statistic" (Preacher and Hayes 2004, pp. 721–722) and that avoids the statistical power problem introduced by nonnormality in the sampling distribution of the indirect effect (Bollen and Stine 1990; see Preacher and Hayes 2004; Shrout and Bolger 2002). Edwards and Lambert (2007) indicated that bootstrapping can be used to handle nonnormal data.

3.2 Measurement Models

Per Anderson and Gerbing's (1988) and Weston and Gore's (2006) recommendations, we first assessed the fit of the measurement models. Because the original method of assigning items to parcels resulted in relatively low intercorrelations between neuroticism parcels (.64, .41, and .58 for correlations between parcels 1 and 2, 1 and 3, and 2 and 3, respectively), we utilized an alternative systematic method of assigning neuroticism items to parcels, assigning the items with highest, lowest, and next to highest factor loadings to parcel 1, items with the third highest, second lowest, and fourth highest factor loadings to parcel 2, and items with the fifth highest and third lowest factor loadings to parcel 3. This method resulted in higher intercorrelations between neuroticism parcels (.75, .65, and .55, respectively) and also a better model fit (e.g., an Akaike Information Criterion or AIC of 172.45 vs. 193.52). The resultant measurement model for PATs as mediators provided an adequate fit to the data given the small sample size (i.e., $N < 500$) and model simplicity (see Weston and Gore 2006): comparative fit index (CFI) = .96; standardized root mean squared residual (SRMR) = .06; root mean square error of approximation (RMSEA) = .08 (90% CI: .06, .10). Table 3 presents factor loadings for this measurement model. Although Chi-square was significant [χ^2 (48, $N = 199$) = 114.78, $p < .001$], this statistic is very sensitive to sample size (see Hooper et al. 2008) and has been deemed unsuitable with even moderately nonnormal distributions (Yu 2002). Therefore, we used the relative or normal χ^2 (χ^2/df) as recommended by Kline (1998) and Wheaton et al. (1977). The resulting value of 2.39 is below 3.0 (Kline 1998) and is thus considered adequate (see Garson 2009).

We next assessed the fit of the measurement model pertaining to constructs in the structural model for ascertaining whether NATs mediated the relationship between

Table 2 Zero order correlations, means, and standard deviations among observed variables

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	*M*	SD
1. PA Par 3	–																		3.72	.74
2. PA Par 2	.75	–																	3.77	.78
3. PA Par 1	.72	.73	–																3.59	.78
4. PT Par 3	.57	.60	.62	–															3.42	.72
5. PT Par 2	.60	.62	.64	.89	–														3.29	.74
6. PT Par 1	.57	.59	.62	.86	.83	–													3.64	.78
7. Neu Par 3	−.40	−.32	−.43	−.47	−.54	−.40	–												2.41	1.00
8. Neu Par 2	−.33	−.27	−.26	−.39	−.46	−.33	.55	–											2.91	.84
9. Neu Par 1	−.41	−.30	−.36	−.48	−.55	−.39	.65	.74	–										3.14	.94
10. Extra Par 3	.35	.36	.34	.36	.37	.46	−.21	−.31	−.18	–									3.25	.89
11. Extra Par 2	.26	.33	.30	.37	.36	.44	−.16	−.13	−.04	.60	–								3.29	.80
12. Extra Par 1	.21	.33	.28	.35	.33	.44	−.08	−.11	.04	.67	.70	–							3.42	.86
13. NA Par 3	−.07	−.04	−.04	−.25	−.29	−.22	.51	.44	.49	−.11	−.07	.08	–						2.55	.93
14. NA Par 2	−.12	−.09	−.01	−.20	−.21	−.17	.48	.44	.40	−.23	−.13	−.04	.77	–					2.23	.93
15. NA Par 1	−.06	−.05	.00	−.24	−.27	−.19	.48	.48	.47	−.18	−.12	.00	.82	.84	–				2.32	.88
16. NT Par 3	−.25	−.23	−.16	−.27	−.27	−.25	.55	.46	.44	−.17	−.14	−.03	.62	.71	.74	–			2.01	.79
17. NT Par 2	−.30	−.25	−.19	−.31	−.29	−.30	.60	.43	.46	−.20	−.18	−.05	.60	.66	.67	.90	–		1.96	.86
18. NT Par 1	−.21	−.17	−.10	−.20	−.18	−.19	.47	.35	.34	−.14	−.17	−.05	.56	.66	.70	.91	.90	–	1.78	.78

$N = 199$. Correlations with an absolute magnitude of .21 or higher are significant at the .001 level; correlations with an absolute magnitude between .17 and .20 are significant at the .01 level; correlations with an absolute magnitude between .12 and .16 are significant at the .05 level; correlations with an absolute magnitude of .11 and below are nonsignificant. *Par* parcel, *PA* positive affect, *PT* positive thoughts, *Neu* neuroticism, *Extra* extraversion, *NA* negative affect, *NT* negative thoughts

Table 3 Factor loadings of the measurement model: positive automatic thoughts as mediators of the relationship between extraversion, neuroticism, and positive affect

Measured variable	Unstandardized factor loadings	SE	*Z*	Standardized factor loadings
Positive affect (PA)				
PA Parcel 1	1.00	–	–	.85
PA Parcel 2	1.03	.07	15.03	.87
PA Parcel 3	.95	.07	14.51	.85
Positive thoughts (PT)				
PT Parcel 1	1.00	–	–	.90
PT Parcel 2	1.00	.05	21.91	.94
PT Parcel 3	.97	.04	22.15	.94
Neuroticism (N)				
N Parcel 1	1.00	–	–	.94
N Parcel 2	.75	.06	12.76	.79
N Parcel 3	.80	.07	11.13	.70
Extraversion (E)				
E Parcel 1	1.00	–	–	.87
E Parcel 2	.85	.07	11.93	.80
E Parcel 3	.90	.08	11.34	.76

$N = 199$. All factor loadings are significant at $p < .001$ level

neuroticism, extraversion, and negative affect. Because extraversion did not predict either NATs or negative affect, it was dropped from the model. This measurement model did not provide a good fit to the data, $\chi^2/df = 4.04$, CFI = .96, SRMR = .06, RMSEA = .12 (90% CI: .10, .15). Table 4 presents factor loadings for this measurement model.

3.3 Structural Models

In light of recent evidence and recommendations (MacKinnon et al. 2004; Mallinckrodt et al. 2006; Preacher and Hayes 2004, 2008), we utilized bias-corrected bootstrapping with 10,000 resamples in order to obtain 95% confidence intervals for directly testing the significance of the hypothesized indirect or mediational effects in the structural model. The structural model for PATs as mediators (see Fig. 1) fit the data adequately, $\chi^2/df = 2.33$, CFI = .96, SRMR = .07, RMSEA = .08 (90% CI: .06, .10). Consistent with hypotheses, all hypothesized direct and indirect paths were significant. As hypothesized, the indirect relationships of extraversion ($\beta = .34$, 95% CI: .25 .42, $p = .002$) and neuroticism ($\beta = -.40$, 95% CI: $-.51, -.30$, $p = .002$) with PA were significant. Table 5 presents zero-order correlations between latent variables in this model; Table 6 presents the results of bootstrap analysis of the magnitude and statistical significance of the direct and indirect effects.

Because other conditions for mediation were met (e.g., extraversion and neuroticism accounted for significant variance in PA when PATs were not included in the model—$\beta = .38$ and $\beta = -.42$, respectively—and the relationship of extraversion and neuroticism with PA became nonsignificant when PATs were included in the model; see Frazier et al. 2004; Holmbeck 2002), this indicated that PATs fully mediated the relationship between neuroticism and extraversion, and PA. The plausible alternative model in which PA was theorized to mediate the relationship between both neuroticism and extraversion and PATs

Table 4 Factor loadings of the measurement model: negative automatic thoughts as mediators of the neuroticism–negative affect relationship

Measured variable	Unstandardized factor loadings	SE	*Z*	Standardized factor loadings
Negative affect (NA)				
NA Parcel 1	1.00	–	–	.95
NA Parcel 2	.99	.05	21.16	.89
NA Parcel 3	.96	.05	19.11	.86
Negative thoughts (PT)				
NT Parcel 1	1.00	–	–	.95
NT Parcel 2	1.10	.04	27.41	.94
NT Parcel 3	1.03	.03	30.46	.97
Neuroticism (N)				
N Parcel 1	1.00	–	–	.89
N Parcel 2	.82	.06	12.88	.82
N Parcel 3	.88	.08	11.35	.73

$N = 199$. All factor loadings are significant at $p < .001$ level

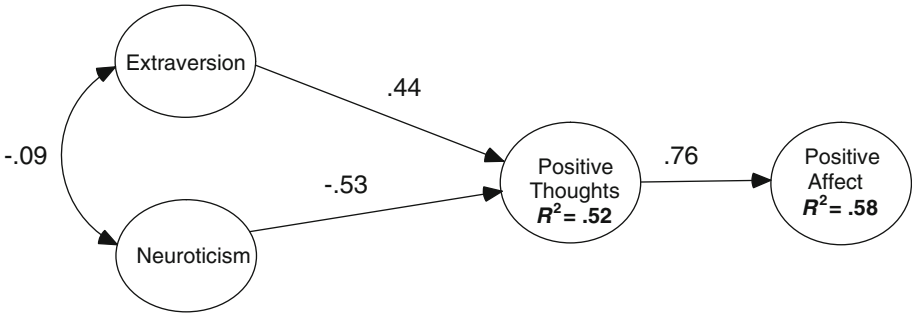

Fig. 1 Structural model: positive automatic cognitions as mediators of the relationship between extraversion, neuroticism, and positive affect

did not fit the data as well, $\chi^2/df = 3.03$, CFI = .94, SRMR = .09, RMSEA = .10 (90% CI: .08, .12). Additionally, the AIC exhibited by this model (207.40), which may be used to compare nonnested models (Arbuckle 2006b), was substantially higher than the AIC of the hypothesized model (172.45), indicating that the hypothesized model provided a better fit to the data.

We next assessed the fit of the structural model in which NATs were conceptualized as mediating the neuroticism–negative affect relationship. In this model, the latent variable negative affect correlated .61 with neuroticism and .78 with NATs, and the latent variable NATs correlated .55 with neuroticism. As anticipated from the poor fit of the measurement model, the model in which NATs were construed as full [$\chi^2/df = 4.46$, CFI = .95, SRMR = .08, RMSEA = .13 (90% CI: .11, .16)] or partial [$\chi^2/df = 4.04$, CFI = .96, SRMR = .06, RMSEA = .12 (90% CI: .10, .15)] mediators of the relationship between neuroticism and negative affect did not provide a good fit to the data according to either RMSEA or χ^2/df. Table 7 presents results of bootstrap analyses of direct and indirect effects of this model. An alternative model in which negative affect was tested as a mediator of the relationship between neuroticism and NATs also did not fit the data well, $\chi^2/df = 4.03$, CFI = .96, SRMR = .07, RMSEA = .12 (90% CI: .099, .149).

Table 5 Zero order correlations among latent variables: positive automatic thoughts as mediators of the relationship between extraversion, neuroticism, and positive affect

$N = 199$

	1	2	3	4
1. Positive affect	–			
2. Positive thoughts	.76	–		
3. Neuroticism	−.46	−.57	–	
4. Extraversion	.42	.49	−.09	–

Table 6 Bootstrap analysis of the magnitude and statistical significance of the direct and indirect effects: positive automatic thoughts as mediators of the relationship between extraversion, neuroticism, and positive affect

Independent variable	Mediator variables	Dependent variable	Beta standardized direct/indirect effect	*B* mean direct/ indirect effect	SE of mean	95% CI[a] (lower, upper)
Extraversion →		Positive thoughts	.41	.409[a]	.058[a]	.294, .522
Extraversion →	Positive thoughts →	Positive affect	(.44) × (.76) = .34	.297	.045	.212, .394
Neuroticism →		Positive thoughts	−.53	−.420[a]	.049[a]	−.517, −.324
Neuroticism →	Positive thoughts →	Positive affect	(−.53) × (.76) = −.40	−.305	.043	−.402, −.231
Positive thoughts →		Positive affect	.76	.725[a]	.064[a]	.596, .851

CI confidence interval

[a] These values are based on unstandardized bootstrapped beta coefficients

4 Discussion

The purpose of this study was to test the hypothesis that trait PATs mediated the well-known relationship between both extraversion and neuroticism and PA. This hypothesis is consistent with theories that accord intermediate-level cognitive processes a key role in mediating the relationship between personality and outcomes (Dweck 2008) and is central to ascertaining whether cognitive and motivational processes linked to happiness can be acquired or taught (see Lyubomirsky 2001 for a discussion of this question).

Results supported our hypothesis: PATs fully mediated the relationship between both extraversion and neuroticism and PA. Moreover, the plausible alternative hypothesis that neuroticism and extraversion directly predicted PA and indirectly predicted PATs through PA received less support in that the model testing this hypothesis exhibited a worse fit to the data (e.g., AIC, RMSEA, and χ^2/df were higher, and CFI was lower, in the alternative model relative to the hypothesized model). The ability of thoughts to mediate the personality–affect relationship did not extend to NATs, however, in that extraversion did not predict NATs or negative affect, and a model in which NATs mediated the neuroticism–negative affect relationship did not fit the data well according to RMSEA or χ^2/df. This finding recalls evidence that client response to cognitive therapy has been more strongly

Table 7 Bootstrap analysis of the magnitude and statistical significance of the direct and indirect effects: negative automatic thoughts as mediators of the neuroticism–negative affect relationship

Independent variable	Mediator variables	Dependent variable	Beta standardized direct/indirect effect	*B* mean direct/ indirect effect	SE of mean	95% CI[a] (lower, upper)
Neuroticism →		Negative thoughts	.56	.494[a]	.079[a]	.350, .668
Neuroticism →	Negative thoughts →	Negative affect	(.56) × (.78) = .44	.440	.076	.304, .604
Negative thoughts →		Negative affect	.78	.888[a]	.064[a]	.770, 1.034

CI confidence interval

[a] These values are based on unstandardized bootstrapped beta coefficients

predicted by changes in positive thinking than by changes in negative thinking (Garamoni et al. 1992), that preexisting level of positive thoughts has predicted success of cognitive therapy (Shiraishi 2005), and that PATs have predicted but NATs have not predicted future happiness (Lightsey 1994a). Taken together, this evidence suggests that PATs may be more pertinent than NATs to predicting positive outcomes as well as mediating the relationship between personality and such outcomes.

To speculate, PATs may—like PA—be linked to approach motivations, goal strivings, and reward sensitivity (see Gray 1987), whereas NATs may, like negative affect, be linked to autonomic right hemispheric "fight or flight" harm-avoidance systems and sensitivity to punishment (see Lightsey 1996, for a discussion). If this is the case, generation of PATs may lead to increased sensitivity to and awareness of rewards and positive environmental and personal characteristics, as well as a penchant for striving for goals. Indeed, frequent PATs may engender a positive mindset that not only allows positive personality characteristics (e.g., extraversion) to foster positive emotion but also confers resilience against negative personal and environmental characteristics via a compensatory positive perspective. Such a positive perspective may allow negative characteristics and events to be seen as less negative, or allow overriding of these "negatives" via noticing and recalling "positives." In contrast, decreasing NATs may reduce sensitivity to punishment signals (see Gray 1987), which may not be sufficient to foster well-being or fully remedy ill-being. Our findings and this argument underscore the possibility that increasing PATs may be a particularly effective means of enhancing well-being and helping to prevent some forms of ill-being such as depression (see Lightsey 1994a, b).

It is important to note that the low correlation between neuroticism and extraversion means that individuals may have widely varying levels of these traits (e.g., one person may have high neuroticism and high extraversion, but another may have low neuroticism and high extraversion). In theory, persons with higher extraversion and lower neuroticism would generate more frequent PATs and hence experience more PA, whereas persons with lower extraversion and higher neuroticism would generate less frequent PATs and hence experience less PA. However, regardless of the individual level of extraversion and neuroticism, our model suggests that frequency of PATs would account for the relationship between levels of extraversion and neuroticism and PA.

These findings are consistent with the idea that personality affects well-being through an effect on cognitive psychological traits—specifically PATs—and with mounting evidence

that thoughts or self-statements affect emotion and well-being. For example, merely reading positive evaluative self-statements has resulted in a more positive mood (and reading negative evaluative self-statements has resulted in a more negative mood) both among characteristically depressed and characteristically elated women (Coleman 1975). Experimental studies have also found that daily repetition of positive self-statements decreases depression and increases self-esteem (Bailey 2004; Philpot and Bamburg 1996). Recent evidence also has indicated that positive self-appraisals with regard to coping with emotions, difficult situations, and social support (i.e., obtaining social support)—which may correspond to at least some PATs (e.g., "I enjoy a challenge," "I won't give up," and "I have friends who support me" from the ATQP)—buffer the relationship between hopelessness and suicidal ideation (Johnson et al. 2010). Similarly, optimistic expectancies, which correspond to one factor on the ATQP, predict cell-mediated immunity partially via enhanced PA, but not via negative affect (Segerstrom and Sephton 2010).

As discussed by Lightsey et al. (in press), positive thoughts have also been found to increase in frequency with remission of depression (Dozois 2007), and the ratio of positive to negative cognitions increases with other therapeutic treatments (e.g., Schwartz and Michelson 1987), suggesting the importance of monitoring levels of PATs and negative thoughts over the course of therapy. If additional studies confirm these results, and given evidence that level of prior positive thoughts predicted cognitive therapy outcome (Shiraishi 2005), it may also be important to build in mechanisms (e.g., homework involving repetition of positive self-statements) that focus on augmenting pre-therapy session levels of PATs. Evidence also suggests that change in thoughts may mediate the effects of treatment on outcomes (Casey et al. 2005), and that—as noted—client response to cognitive therapy is more strongly predicted by changes in positive thinking than by changes in negative thinking (Garamoni et al. 1992), although NATs, too, have been found to mediate the effects of group cognitive-behavioral therapy on depression (Kaufman et al. 2005). Such studies suggest that monitoring or assessing client PATs and negative thoughts during psychotherapy could result in more thorough and accurate assessment of client progress as well as derivation of more precise interventions (see Lightsey et al. in press).

Several methods to increase PATs are available. As noted, simple rehearsal of positive and adaptive thoughts may have noteworthy benefits (Bailey 2004; Philpot and Bamburg 1996), and several techniques that fall under the rubric of "optimism training" (Riskind et al. 1996) may be helpful in increasing PATs. For example, learning to identify dysfunctional negative beliefs and replace them with positive beliefs, to visualize positive and desirable future outcomes, and to identify positive elements in even negative situations may result in more frequent positive cognitions. Traditional cognitive-behavioral therapies such as those of Beck and his colleagues (e.g., Beck et al. 1979; Beck and Weishaar 1989) have amassed considerable evidence for their effectiveness in relieving particular problems such as depression and may also be used to increase positive cognitions. Similarly, although the empirical evidence for his approach is less strong, techniques championed by Ellis (e.g., Ellis et al. 1998) also have great potential for increasing positive thoughts.

These findings should be interpreted in light of the study's limitations. The cross-sectional, correlational design cannot ascertain causality, and the findings may not generalize to populations other than college students, who comprised most of the sample. Although all instruments are well-validated, all are also self-report, and the possibility of mono-method bias therefore cannot be ruled out. However, it should be stressed that all instruments have demonstrated excellent reliability and validity and have been validated against not only self-report measures but against other criteria.

Additionally, it may be questioned whether the construct measured by the "trait" ATQP is in fact automatic thoughts or, rather, attitudes or beliefs [as described above, cognitive theorists such as Beck (1967) generally have hypothesized that automatic thoughts arise when deep beliefs are activated]. It should be noted in this regard that the factorial structures of state and trait versions of the ATQP are identical (Lightsey 1992), that the trait ATQP has correlated .85 with the state ATQP, and that its 6-week test–retest correlation of .65 is only incrementally higher than the 6-week test–retest correlation of the original ATQP (.56; Lightsey 1992). These data suggest that the trait ATQP measures a construct strongly akin to the state ("over the past week") thoughts measured by the original ATQP, although it remains possible that both state and trait versions of the ATQP are measures of deeper beliefs rather than automatic thoughts per se. If, however, habitual forms of automatic thinking exist and influence both life experiences and affect (e.g., Lightsey 1994a; McKellar et al. 1996), a large body of previous work (e.g., Watson et al. 1988; Zuckerman 1960, 1983) indicates that utilization of trait instrument instructions would best tap these habitual styles. It should be emphasized that, regardless of whether the ATQP measures thinking or beliefs, both constructs are amenable to therapeutic change via empirically validated methods such as Beck's cognitive behavioral therapy.

Finally, it should be noted that, in many situations, the relationship between PATs and PA is likely to be bi-directional, and both could arise concomitantly (e.g., when receiving a gift, winning an award, or accomplishing an important goal). For example, a large body of research indicates that mood and feelings affect self-efficacy (see Bandura 1997), careful thinking and problem-solving (see Isen 2004), cognitive flexibility (see Isen 2002), processing of and memory for social information (see Bower and Forgas 2001) and many other forms of cognition. However, much of the existing research consists of experimental laboratory studies, and the sole longitudinal studies we are aware of that examine the temporal relationship between PATs and PA in naturalistic settings (Lightsey et al. 2011) indicate that, consistent with the present results, PATs predict PA, but PA does not predict PATs. Conduct of field-based studies of the PATs–PA relationship is vital given the limitations of laboratory-based studies of affect and cognitions, including generation of spurious and confounding emotions, limited intensity of personal engagement and generated emotions, and artificially-restricted setting elements that limit generalizability (see Lazarus 1995).

Longitudinal studies that ascertain whether state as well as trait PATs mediate the relationship between personality and future PA are recommended in order to provide stronger causal evidence. Utilization of larger and more diverse samples, or samples from alternative populations, could help to determine generalizability of the findings. Measuring thoughts by alternative methods such as thought listing, and having personality and affect ratings corroborated by reports of others who know the participants, could serve as a check on mono-method bias and could ascertain whether results generalize to other methods. Daily-diary studies in which PATs and PA are assessed repeatedly over time could provide rich information about not only causal direction but within-person mechanisms via which PATs could affect PA. Experimental studies comparing the effects on PA of PATs augmentation versus a control intervention for persons high or low in extraversion and neuroticism would provide still stronger causal evidence for the ability of PATs to mediate the personality–PA relationship. Finally, including measures of positive beliefs as well as measures of PATs could help rule out the alternative possibility that the ATQP measures beliefs rather than thoughts, and that beliefs mediate the relationship between personality and PA.

Despite limitations, our study has provided initial evidence for the mechanism via which personality dimensions may affect well-being. Further corroboration of these results, and direct examination of their clinical benefits, awaits future studies.

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